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PLANT GROWING

Influence of Furolan-Treated Seeds on Sowing Characteristics of Winter Wheat Cultivars[1]

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Abstract—The study was carried out at the All-Russian Rice Research Institute, Belozerny, Krasnodar, Russia in 2009. The seeds of three varieties of winter wheat namely; Bat'ko, Deya and Krasnodarskaya 99 were grown in different concentrations of growth regulators namely; Furolan, (2-furyl-2)-1,3-dioxolane, gibberellins (plant hormone) and water as control. The influence of the growth regulators on seed germination energy and germinating power were determined. The effect of the regulators was higher in all the experimental variants than in the control. However, this increase was insignificant ($LSD_{0.05} = 6.88$). Application of Furolan in concentration of 0.001 and 0.0001% in Deya's variety decreased germination energy in comparison with that of concentration 0.01%. Weak concentration virtually did not stimulate germination energy of seeds. The different varieties investigated in this study showed very positive response to growth regulators at different stages of ontogenesis of the plants. The effect of the factor B (growth regulators) on the formation of sprout length was 11.7%. Interaction of factors A and B was very small; its effect was only 0.6%.

Keywords: gibberellins; Furolan; germination energy; laboratory germinating power; biometrical parameters; winter wheat varieties

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1. INTRODUCTION

Presently, 53 varieties of winter (soft) wheat have been catalogued in Krasnodar region of Russia. For many of these wheat varieties, high-quality techniques and technologically certified methods have been developed for their cultivation according to their zones (2010 Catalogue).

At this stage of human history, when significant success has been achieved in science particularly in the study of wheat as a major food source, mention should be made about the so-called "biologization" of technology, which refers to the maximum coordination in the biological requirements of plant cultivars.

Mineral fertilizers appear as the factor in control and management of plant growth and development, as well as in the productivity and quality of the seeds. Plant growth regulators are widely applied in the integrated plant development. Growth regulators improved germination power of seed, increased yield and enhanced resistance of plants to diseases and unfavourable growth conditions and produced early and qualitative yield (Halter et al., 2005; Kadiri et al., 1997; Papadopoulos et al., 2006; Saglam et al., 2002).

'Biologization' of cultivation technology of winter wheat varieties ensured the utilization of micro fertilizers and growth regulators. In this study, the growth regulator, Furolan was used to investigate the influence of the growth regulators on seed germination energy and germinating power of winter wheat grains in addition to mineral fertilizers. Furolan was created by KubSUT (Kuban State University of Technology) (Koslina et al., 1997; Nenco et al., 1995; Nenco et al., 2005). The name of the active substance of Furolan according to ISO is—2-(1, 3-dioksolanyl-2) furan and by IUPAC—(2-furil)-1, 3—dioksolan. Furolan—is a colorless liquid with weak characteristic acetylene smell, containing 98.89% of active substance, 2 (1, 3 dioksolanyl-2) furan, soluble in water and adequately soluble in organic solvents. Furolan shows antistress activity and is permitted for use in Russia on a variety of agricultural crops, including wheat (Nenco et al., 2005). Furolan could be classified as average toxic compound (LD50 = 511–626 mg/kg). Seeds of winter wheat varieties are soaked in different concentration of solutions of Furolan. Thereafter, effects of Furolan on energy of germination and germinating power of the seeds, growth and development of the sprouts and primary root system were determined.

2. MATERIALS AND METHODS

2.1. Determination of the Stimulation Dose of Growth Regulator for Optimum Growth

For the purpose of determination of the stimulation dose for optimum growth the experiment was conducted in laboratory conditions. Two growth regu-

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Table 1. The influence of growth regulators on sowing qualities of seeds of winter wheat varieties (2007–2009)

Variety, factor A	Growth regulators and their concs., %, factor B	Germinat ion energy of seeds, %	Laboratory germinating power of seeds, %	Length of sprouts, cm	Root length, cm
Bat'ko	Control	79.3	88.9	8.2	7.7
	Gibberellins 0.001	81.4	90.6	9.5	7.9
	Furolan 0.01	80.6	89.4	9.7	8.4
	0.001	82.7	88.7	10.0	8.9
	0.0001	82.9	90.3	9.8	8.5
Deya	Control	85.2	88.7	8.1	7.9
	Gibberellins 0.001	88.3	91.2	9.3	8.3
	Furolan 0.01	87.4	90.6	9.6	8.7
	0.001	80.9	89.8	9.9	8.9
	0.0001	87.3	91.7	9.5	8.6
Krasnodarskaya 99	Control	80.2	85.1	9.7	9.1
	Gibberellins 0.001	85.4	92.7	11.2	9.8
	Furolan 0.01	84.6	90.9	11.6	10.9
	0.001	90.3	94.6	12.0	11.8
	0.0001	88.6	90.3	11.5	10.2
$LSD_{0.05}$		6.88	6.13	0.23	0.13

lators were used: gibberellins (concentration of 0.001%) and Furolan (three concentrations: 0.1; 0.001 and 0.0001%).

The quantity of growth regulator to mass of seeds used was evaluated thus: 0.01%—corresponded to 10.0 g/tonne and 0.001%—1.0g/tonne. Seeds were soaked in petri dishes and the growth solutions were prepared. After 5–7 days, energy of the sprouts and laboratory germinating power were determined respectively. After 15 days the sprout dimensions and primary root systems were determined.

2.2. Determination of Seed Germination Energy

After 5 days germination energy of the sprouts were determined. Germination energy, defined as the germination percentages when the mean daily germination (cumulative germination percent divided by the time elapsed since sowing date) reached its peak, was also determined. Germination energy is also a measure of the vigour of seedling produced.

2.3. Determination of Laboratory Germinating Power

Germinating power of seeds is the ability of the seeds of agricultural crops to germinate quickly and at the same time. It is determined along with the germination rate and is defined as the number of seeds (in percent) that germinate in a period of time specified for each crop; for example, for field crops, the period is three to five days. After 7 days laboratory germinating power were determined.

3. RESULTS AND DISCUSSION

3.1. Influence of Furolan on Sowing Characteristics of Seeds of Winter Wheat Varieties During their Pre-sowing Treatment

Results of effect (in %) of growth regulators on the sowing characteristics of the seeds of winter wheat varieties are presented in Table 1.

It is believed that pre-sowing treatment of winter wheat seeds by growth regulators leads to increase of germination energy and laboratory germination power (Brocklehurst et. al., 1982; Bugbee and White, 1984) intensifying growth and development of sprouts.

It could be seen from Table 1 that in all the laboratory experimental variants, growth regulators stimulated germination energy of the seeds. The effect of the regulators was higher in all the experimental variants than in the control (Boehme et. al., 2005; Panajotov, 1997). However, this increase was insignificant

Table 2. Effect of different variation types on the formation of germination energy, laboratory germinating power and other biological factors in winter (soft) wheat varieties (%) (2007–2009)

Types of variation	Germination energy, %	Laboratory germinating power, %	Length of sprouts, %	Root length, %
General	57.3	54.8	34.1	34.5
Experimental Replicates	0.3	0.9	2.1	2.5
Variants	23.4	11.6	31.9	31.7
Factor A	7.6	9.7	19.6	22.3
Factor B	2.6	12.2	11.7	7.6
Sum of interactions AB	8.8	10.8	0.6	1.4

($LSD_{0.05}$ = 6.88). Using Furolan in concentration of 0.001 and 0.0001% on Deya's variety, germination energy decreased in comparison with concentration of 0.01%. Weak concentration virtually did not stimulate germination energy of seeds.

The growth regulator, gibbberellin stimulated germination energy of seeds (Andreoli and Khan, 1999; Lada et. al., 2005; Lopez-Elias et. al., 2007), but its values were similar to those of the variants subjected to Furolan.

Laboratory germinating power of seeds increased under the influence of growth regulators in comparison with control (Ugur and Kavak, 2007). However, this increase was insignificant.

On the basis of two-factorial dispersion analysis the effect of Furolan (expressed in %) during the formation of germination energy and laboratory germinating power was determined (Table 2).

During germination of seeds of winter wheat varieties the effect of the general variation, in which case, included all the ecological factors (namely humidity, temperature, light etc) on the formation of germination energy was 57.3%.

The effect of experimental variants (genotypes of the varieties and growth regulators) on germination energy was 23.4%. The effect of genotypes of varieties for the germination energy obtained was 7.6%. This indicated a very weak effect, (Pasian and Bennett, 1999).

The effect of the factor B (growth regulators) during the formation of germination energy amounted to 2.6%. This showed a weak stimulating effect. Probably, in this case it would be necessary to use other concentrations of growth substances.

Laboratory germinating power of seeds also depended on variation types. So the influence of the general variation in quantity of laboratory germinating power amounted to 54.8%. The effect of experimental variants on laboratory germinating power of seeds was 11.6%. The effect of genotypes of varieties during the formation germinating power of seeds was 9.7%. In this case, was observed the response of varieties to growth regulators. A similar trend was observed in terms of the effect of growth regulators on index of seed germinating power. It amounted to 12.2%. Growth regulators mobilized all enzymes for increase in germinating power of seeds.

In the course of 15 days after sprouting, the length of the sprouts and the roots were determined. From the table, it could be seen that the length of sprouts in the winter (soft) wheat varieties under the influence of growth regulators in all the variants were significant exceeding the control ($LSD_{0.05}$ = 0.23). The longest sprouts were formed in Krasnodarskaya 99 variety. Their length varied from 9.7 cm (control) to 12.0 cm (Furolan; concentration of 0.001%). All these differences were significant, (Magnitskiy, 2006).

The effect of the general variation on the formation of length of sprouts was 34.1%. This effect of experimental variants on formation of length of sprouts was 31.9%. The influence of genotypes of varieties and concentration of growth regulators on the length of sprouts was highly positive. The influence of varieties (genotypes) on the formation of sprout length was 19.6%. This was a strong effect. The varieties used in this investigation showed very positive response to growth regulators at different stages ontogenesis of the plants. The effect of the factor B (growth regulators) on the formation of sprout length was 11.7%. Interaction of factors A and B was very small, and its effect (in %) was only 0.6%.

The root length in the winter wheat varieties under the influence of growth regulators statistically increased significantly, (Brigard, 2006). For factor A (variety) it varied from 8.4 cm (Bat'ko); 8.5—(Deya) to 11.8 cm (Krasnodarskaya 99), ($LSD_{0.05}$ = 0.10).

The effect of the general variation on the formation of length of roots formed 34.5%. This was a moderate effect on the root length. The effect of experimental variants in the formation of root length of winter wheat varieties was 31.7%. This was a positive effect.

4. CONCLUSION

Activation of growth and synthetic processes in sprouts of winter wheat varieties investigated by Furolan is connected with greater photosynthesis efficiency, protein synthesis etc. Thus, Furolan increases germinating power of winter wheat seeds, activates growth of sprouts, increases biomass accumulation in stem and root systems that is connected with more intensive photosynthesis and protein synthesis.

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